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16. Abstract The objective of this project is to determine the feasibility of detecting caribou aggregations, caribou trail systems, extensively cratered winter feeding areas, seasonal changes in snowcover, and distribution of caribou habitat on ERTS MSS imagery. Findings to date indicate that some habitat determinations can be made with band 6 imagery of northern coniferous forest areas. Color additive display analyses yield even more information on habitat types and either single band or composite data products may be used to map progressive changes in seasonal snowcover. Digital tapes of selected scenes have not yet arrived nor has the digital color display unit ordered by project 110-1. When the tapes and equipment do arrive, however, positive results are anticipated regarding detection of caribou aggregations, heavily used trail systems, and extensively cratered winter feeding areas.			
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I INTRODUCTION

This report summarizes the work performed and conclusions reached during the first six months of contract no. NAS5-21833, ERTS-1 project no. 110-7, Application of ERTS-1 imagery to the study of caribou movements and winter dispersal in relation to prevailing snowcover. The first ERTS scenes were received in late August and data began arriving in quantity during early October. A screening procedure was employed to determine which scenes would be photographically reproduced and a tri-partite file system was developed.

Caribou distribution and movements in northeast Alaska were cooperatively determined through joint efforts of the Alaska Department of Fish and Game, the Arctic National Wildlife Range, and ourselves. Through the cooperative efforts of Dr. Robert LeResche (ADF&G), we obtained vegetation type maps of the Alaskan Arctic Coastal Plain east of the Canning River (1:250,000 and 1:63,360), caribou trail maps (1:250,000 and 1:63,360), of the same area, and floristics/per cent cover transects of wet meadow, riparian willow, and tussock communities in this area.

Initial analytic effort emphasized examination of 9.5" single band prints and 70mm positive transparencies under magnification. Late in December 1972, a color additive viewer became operational under project 110-1 and our analytic emphasis shifted to the use of this device.

II STATUS OF THE PROJECT

A. Objectives: Overall objectives of the project are to test the feasibility of using ERTS-1 MSS outputs to detect and map environmental features resulting from the activities of large caribou aggregations and to correlate seasonal changes in snowcover distribution (as determined by ERTS-1 imagery) with information on caribou distribution and movements (as determined by aerial reconnaissance). Immediate objectives during the reporting period were:

1. To establish a filing system and master record of data products on hand thus permitting data analysis to proceed in logical and orderly fashion.
2. Development of a systematic selective screening procedure to determine which scenes will be analysed and the method of analysis to be applied.
3. To determine whether individual single band MSS images can provide pertinent information relative to our objectives.

4. To begin color additive display analyses and development of the photographic expertise required to achieve useful photographic reproductions of displays.
5. Cultivation of a strong cooperative working relationship with the Alaska Department of Fish and Game and Arctic National Wildlife Range personnel.
6. To monitor caribou distribution and movements in northeast Alaska during the reporting period.
7. To obtain a mapping of heavily used caribou trail systems on the Alaskan Arctic Coastal Plain east of the Canning River.
8. To obtain some data on progressive snow depths on caribou wintering areas in northeast Alaska.
9. To obtain vegetation type maps of selected caribou range in northeast Alaska.

The relationship of points 1 through 4 and 6 through 9 to overall project objectives is obvious. Point 5 was and is essential to achievement of field related objectives as well as overall project objectives.

B. Accomplishments during the reporting period

1. Field accomplishments - Distribution and movements of the Porcupine caribou herd during the reporting period were determined by extensive aerial reconnaissance flights carried out by the Alaska Department of Fish and Game, the Arctic National Wildlife Range, and ourselves. Flight data is available for the following dates: 21 July, 29 July, 2 Aug., 22 Aug., 23 Aug., 25 Aug., 26 Aug., 27 Aug., 28 Aug., 29 Aug., 30 Aug., 2 Sept., 8 Oct., 16 Nov., 20 Nov., 27 Nov., and 28 Nov. These reconnaissance results are summarized in LaPerriere 1972 and LeResche 1973.

Field data for mapping of heavily used caribou trail systems and vegetation type maps of the Alaskan Arctic Coastal Plain east of the Canning River were obtained by Dr. Robert LeResche (ADF&G) during the past summer. In January, Dr. LeResche completed preparation of these map products and made them available for our use in imagery analysis.

Snow depth data were obtained in the Middle Fork of the Chandalar on November 20th and similar data was obtained for the Junjik Valley on November 28th. Results are summarized in LaPerriere 1972.

Field activities were terminated in late November because satellite coverage was terminated, extremely low temperatures are hazardous to aircraft operation, and the short day length makes reconnaissance efforts impractical. Field work is scheduled to resume in late February.

2. Data Handling Accomplishments - A filing and processing system was developed to cope with the relatively large volume of incoming data. Three files were established: a file for 70mm positive transparencies, a file for 70mm negative transparencies, and a file for 9.5" paper prints. A master record is maintained which indicates scenes on hand, type of data products for each scene, approximate geographical area of each scene, and the extent of cloud cover over areas of special interest to us. Incoming negatives are filed routinely by scene number but 70mm positive transparencies are not filed until they have been examined. The information for the master record and a disposition on future analysis is based upon this examination of the 70mm positive transparency.

3. Preliminary Investigations - During the preliminary screening examination of scene 1051-21002, it was noticed that stands of relatively dense white spruce appeared light gray while adjacent boggy areas were darker on MSS bands 6 and 7. The project coinvestigator had a field camp last April near the confluence of Water Creek and the Junjik River and, in this particular area, the distribution of light and dark areas particularly on MSS band 6 seemed to correspond fairly well with the spruce/bog distribution observed from the field camp. On November 28th, we obtained low level aerial photography of this area and examination of the photo outputs verified our initial impressions. Black and white enlarged prints (1:250,000) of bands 6 and 7 were made and, after initial examination, band 7 prints were judged inferior to band 6 prints for our purposes. Acetate overlays of spruce and bog distribution were prepared from band 6 prints and similar acetate overlays of "forest vegetation and marsh" were prepared from 1:250,000 USGS maps of the area. The USGS map used was prepared from aerial photographs obtained in 1955. Correspondence between the overlays was good in some areas and poor in other areas. The reasons for this are as follows: First, there are two types of spruce in the interior, namely, white spruce and black spruce. The white spruce normally occurs in denser stands on relatively well drained sites whereas the black spruce occurs at lower density on moister sites commonly called "muskeg". We believe that the light and dark patterns of the valley floors on MSS band 6 are really a measure of surface moisture and, because vegetation is highly correlated with moisture levels in our climate, these moisture patterns can be used to identify vegetation types. In cases of gradual change, however, it is difficult to determine exactly where to draw the line separating vegetation types. For example, if a white spruce stand (dry) ends abruptly and is bordered by a bog (wet), the dividing line between the vegetation types is easily seen on MSS band 6. However, if the white spruce stand (dry) gradually merges into low density black spruce muskeg (moist) which in turn gradually merges into a treeless bog (wet), it is very difficult to determine exactly where division

lines should be placed. Second, the areas represented as "forest vegetation" on the USGS maps are not necessarily spruce. Some of the area represented as "forest vegetation" may be riparian willow or even patches of birch and alder which would be found on even drier sites than white spruce.

Aerial reconnaissance during October and November indicated many thousands of caribou wintering in the study area. Therefore, thousands of animals are no doubt present against a background of snowcover on scenes 1086-20545, 1087-21004, 1087-21010, 1088-21062, 1102-20434, 1102-21441, 1103-20493, 1103-20495, and 1105-21010. Positive transparencies (70mm) were examined under magnification for known concentrations of caribou and various color additive displays of scenes 1051-21002, 1063-20271, 1086-20543, 1087-21004, 1103-20502, and 1105-21010 were created and photographed. Kodachrome II film in 35mm format and high speed daylight Ektachrome film in 70mm format were used for the color photography. The reasons we made these slides are to provide a permanent record of displays, to project displays on a light table for mapping of certain features, and for later use in presentations. We have not yet had the opportunity to extensively analyse resulting photo products but our first impressions are that the Ektachrome is better for green vegetation displays whereas the Kodachrome seems to be better for red vegetation displays. Neither film, however, appears to be entirely satisfactory for color photos of color additive displays.

4. Applicability of ERTS-1 data to project objectives - Features of particular interest to us on ERTS scenes are aggregations of caribou, caribou trail systems, extensively cratered winter feeding areas, progressive changes in seasonal snowcover particularly during the spring, and the distribution of different caribou habitat types. To date, we have not been able to detect caribou aggregations, trail systems, or winter feeding areas by simple examination of single band products under magnification or in color additive display analyses. The mapping of progressive changes in seasonal snowcover should be relatively simple as evidenced by our examination of single band and color additive displays of scenes 1051-21002 and 1063-20271. Certain caribou habitat types can be distinguished on single band imagery (e.g., valley bottom spruce on scene 1051-21002-6) and readily distinguished on color additive display analyses (e.g., several or more distinct vegetation types are easily discerned on color additive displays of scenes 1051-21002 and 1063-20271). We currently believe that caribou aggregations, heavily used trail systems, and extensively cratered winter feeding areas can be identified with digital density slicing by computer or digital color display. These methods have not yet been applied, however, because digital tapes recently requested from NDPF have not yet arrived and the digital color display unit contracted by project 110-7 for delivery in 1972 has not yet arrived.

However, when the tapes and digital color display equipment do arrive, we are hopeful that such features as large aggregates of caribou, heavily used trail systems, and winter feeding areas will be to some

extent detectable with digital analyses. Additionally, our analysis of scene 1051-21002-6 strongly suggests that digital analysis of MSS band 6 will be very promising for definitive vegetative analyses of northern coniferous forest areas.

5. Results - Work to date strongly suggests that different habitat types are readily detected and can be mapped from ERTS MSS imagery. Enormous potential application of this type of mapping exists in Alaska. Future users of ERTS produced wildlife habitat maps include game management agencies, park and refuge personnel, and all types of land use planning agencies.

III NEW TECHNOLOGY

None.

IV PLANS FOR NEXT REPORTING PERIOD

The following field activity is planned during the coming reporting period: During late February, March, and April, reconnaissance information will be obtained with particular emphasis on the Middle Fork of the Chandalar, the North Fork of the Chandalar, the Wind River, Ottertall Creek, the Junjik valley, the environs of Old John Lake, portions of the Sheenjek valley, and various high meadows in the same general area. One or more spring field camps will be established most probably in April to obtain snow measurements on wintering areas. Considering existing distribution data, the most likely choices for these camps are the Junjik valley, the Wind River valley, and the Middle Fork of the Chandalar. Aerial photography of changing snow conditions will be obtained during the annual spring migration in May. During July and August, vegetation survey information on caribou winter range will be obtained from the Middle Fork of the Chandalar, the Wind River valley, the Junjik valley, and possibly from two other areas.

Analytic effort will continue between field periods from late February through May. Little fieldwork is anticipated in June because that month is not normally suitable for our operations. Operation with ski-equipped aircraft is hazardous because the ice is weakening and operation with float equipped aircraft is hazardous because of large cakes of floating ice. Therefore, most of June will be devoted to analytic effort and, hopefully, emphasis will be on digital analyses of Fall imagery contingent upon data and equipment arrivals. Selected portions of Fall scenes will be analysed in an attempt to identify caribou aggregations, heavily used trail systems, and winter feeding areas. If such identification proves feasible, aerial survey estimates of animal numbers will be applied interpretively in an effort to develop a survey technique for estimating animal numbers from ERTS imagery. At the end of June and early July, large caribou aggregations in northwest Alaska will be mapped using light aircraft during ERTS-1 overflight periods in that areas.

V CONCLUSIONS

ERTS-1 imagery can be used to map caribou habitat. Neither high speed daylight Ektachrome nor Kodachrome II films give entirely satisfactory color photographic results of color additive displays.

VI RECOMMENDATIONS

None.

VII PUBLICATIONS

None.

VIII REFERENCES

LaPerriere, A.J. Feasibility of remote sensing in range evaluation and determination of seasonal caribou distribution in northeast Alaska. Alaska Cooperative Wildlife Research Unit Quarterly Progress Report, October to December, 1972. pp.6-10.

LeResche, R.E. Summary of significant observations of Porcupine and Arctic caribou herds in Alaska 1972. Alaska Dept. of Fish and Game. January 1973. 12p. mimeo.

APPENDIX A - CHANGES IN STANDING ORDER FORM

None.

APPENDIX B

ERTS DATA REQUEST FORM
560-213 (7/72)

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D _____
N _____
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6. CATALOGUES DESIRED

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1066-20433	N6650 W14326	M	D	9		1	U
1066-20442	N6409 W14619	M	D	9		1	U

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	Snow	Clouds	Mtns.	
103020424M	X	X	X	Coastline, estuary
109520042M	X	X	X	River drainages
108220313M	X	X		Mackenzie delta
108220322M	X	X	X	Spruce forest
108220324M	X	X	X	River drainages
109520044M	X	X	X	River drainages
108220331M	X	X	X	
110320502M	X	X	X	Frozen lakes, Airfields
110020315M	X	X	X	Coastline, Island
110020321M	X	X	X	Mosquito heaven
110020324M	X	X	X	Spruce Forest
110320493M	X	X	X	Frozen lakes
110320495M	X		X	Major rivers' confluence
110521012M	X	X	X	Yukon Flats
110521010M	X		X	Braided streams
110020330M	X	X	X	River drainages
110220434M	X	X	X	Major river confluence
110220441M	X		X	Major river confluence
110220443M	X	X	X	Mountain drainages

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APPENDIX D

THIRD BI-MONTHLY PROGRESS REPORT
UNIVERSITY OF ALASKA
ERTS PROJECT 110-7
January 30, 1973

PRINCIPAL INVESTIGATOR: Peter C. Lent

TITLE OF INVESTIGATION: Application of ERTS-1 imagery to the study of caribou movements and winter dispersal in relation to prevailing snowcover.

DISCIPLINE: Environment

SUBDISCIPLINE: Phenology/Wildlife Habitat Surveys

SUMMARY OF SIGNIFICANT RESULTS: Distribution maps of riparian willow on the Arctic North Slope were obtained from cooperating biologists and are now available as ground truth for vegetative analyses of selected ERTS scenes.